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INFORMATION ON SOVIET BLOC INTERNATIONAL GEOPHYSICAL COOPERATION - 1960

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INTERNATIONAL GEOPHYSICAL COOPERATION PROGRAM-- SOVIET-BLOC ACTIVITIES

Table of Contents

I. GENERAL

Importance of IGY Materials Stressed by Belousov

The year 1959 marked the wide development of investigations according to the program of the IGC, the continuation of the work of the IGY.

Great importance is attached to the work on the reduction and publication of the very valuable material obtained by scientists as a result of joint investigations. This problem was discussed by the presidium of the Academy of Sciences USSR on 11 December.

Academician I. P. Bardin, chairman of the Interdepartmental Committee for the Conduct of the IGY, in his opening address, emphasized two problems now confronting scientists: the wide participation in the collection and publication of the results of observations and the continuation in 1960 and succeeding years of the high level of research in stations, observatories, and expeditions.

V. V. Belousov, Corresponding Member of the Academy of Sciences USSR, spoke in detail on these tasks.

The principal wealth obtained as a result of the IGY is the numerous records illustrating the continuing course of the most varied geophysical processes over the surface of the entire planet. The care of these materials and their use, noted Belousov, must stand as the duty of our generation of geophysicists. In these materials are concentrated the forces of the 66 countries participating in the IGY. Their analysis and generalization will require many years of work and the close international cooperation of scientists. ("The Duty of Our Generation of Geophysicists"; Moscow, Pravda, 12 Dec 59, p 4)

Moscow Planetarium Marks 30th Year

The Moscow Planetarium has been in existence for 30 years. Since its opening, more than 26 million persons have visited it and more than 66,000 lectures have been given. ("Planetarium -- 30 Years"; Moscow, Izvestiya, 16 Dec 59, p 4)

Lenin Prize Aspirants

The Odessa State University imeni I. I. Mechnikov has submitted the work, "Complex Work on the Development of Methods, Apparatus, and the Organization of Investigations in the USSR for the Radar Location of

Meteors (IGY-IGC Periods)," by V. P. Tsesevich, B. L. Kashcheyev, B. S. Dudnik, I. A. Lysenko, Ye. I. Fialko, F. I. Peregudov, K. V. Kostylev, and Yu. A. Loshchilov, in the competition for Lenin Prizes for 1960, in the field of Physicomathematical Sciences.

The Main Astronomical Observatory of the Academy of Sciences USSR has submitted the work, "Antenna With a Variable Profile Reflector for Radio Telescopes," by S. E. Khaykin, N. L. Kaydanovskiy, and N. A. Esepkina, in the competition in the field of Instrument Building and Means of Automation. (Moscow, Izvestiya, 19 Dec 59, p 3)

II. ROCKETS AND ARTIFICIAL EARTH SATELLITES

Report on Observation of Sodium Cloud by Kazakh Astrophysics Institute

The following is an account by A. V. Kurchakov of the observation of the sodium cloud of the second Soviet cosmic rocket at the Institute of Astrophysics, Academy of Sciences Kazakh SSR.

A cosmic rocket to the Moon was launched on 12 September 1959 from the territory of the Soviet Union.

The entry of the rocket into orbit and its subsequent flight was observed with radio instruments. The creation of an artificial comet was provided for optical observations of the rocket's motion.

Sodium in the rocket was evaporated and ejected from the rocket at a specific moment. Resonance fluorescence of the sodium vapors occurred in the 5893 Angstrom line.

The Institute of Astrophysics, Academy of Sciences Kazakh SSR, carefully prepared for observations of the flare which was expected 15 degrees from the Moon. The intense background light from the Moon made observations difficult. The matter was simplified by the fact that the scattered light of the Moon made a blue background, but the luminescence of the flare occurred in the yellow part of the spectrum. Therefore, it was decided to place a yellow filter, which would cut the blue background of the sky, in front of the photographic plates. In this case, however, the brightness of star images was also weakened. If the image of the flare proved to be weak on the photograph, then it would be difficult to say which of these images it was: the flare, a weak star, or a defect. To eliminate errors in the identification of the flare, for a certain time up to the moment of its appearance, when the Moon was far from the designated region and the background created by it was small, this part of the sky was photographed. This made it possible to photograph stars up to the 12th magnitude without any noticeable background.

Apparatus for photographing the artificial comet prepared was a powerful meniscus telescope with a 50-centimeter mirror diameter and a focal distance of 120 centimeters, a "NAFA" camera with a 1:2.5 lens, two "Komet A" cameras with 1:2.5 and 1:5 lenses, respectively, and two binoculars.

Observations on the meniscus telescope were made by D. A. Rozhkovskiy, M. G. Karimov. and A. V. Kurchakov; on the "NAFA" camera by T. B. Omarov and E. S. Yeroshevich; and on the other cameras by V. S. Matyagin, M. A. Svechnikov, and K. G. Dzhakusheva.

A division of the time and length of exposure was made in accordance with data on the time and coordinates of the flare. At the moment of the flare the sky was clear and the Moon shone brightly. For several minutes (on the meniscus for 4 minutes and on the rest of the instruments for 15 minutes) before the ephemeral moment of the flare of the sodium cloud, its photographing was begun. Interference filters, tested in detail in the laboratory, were used on all the instruments. Inasmuch as the flare occurred somewhat later than was predicted the sodium cloud was caught by the "Komet A" camera and the meniscus telescope. The sodium cloud was recorded at these moments:

Frame No	Moment of Exposure: Beginning	Moment of Exposure: End	Remarks
10	1848:29 hours	1850:52 hours	Dense formation noted
11	1859:55 hours	1853:19 hours	The cloud became ring-shaped with considerable brightness on one side
12	1853:22 hours	1856:37 hours	The cloud expanded

On the menicus telescope, on the last photographic plate there is a bright cloud; the beginning of the exposure was 1849:54 hours, end of exposure, 1851:54 hours. Determination of coordinates was made according to reference stars and it was established that the flare had the coordinates: 20 hours 35.6 minutes right ascension, and minus 9.1 degrees declination. Out-of-focus pictures of stars for standardization were made for all the consecutive photographs.

A more careful study of the expansion of the cloud, the measurement of its brightness in the different stages of its development, is planned in the future. According to the data obtained, it is possible to judge the density of the interplanetary medium, the thermal velocity of the cloud particles, etc.

It can be said, judging from the ring-shaped form of the cloud, that the concentration of particles in it at this stage and the density of the interplanetary medium is small. The irregular distribution of brightness reveals the presence of a velocity gradient of the dispersing particles. ("Observation of the Artificial Comet," by A. V. Kurchakov; Alma-Ata, Vestnik Akademii Nauk Kazakhskoy SSSR, No 10, Oct 59, pp 97-99)

III. UPPER ATMOSPHERE

Criticism of Al'pert Article on Method of Studying the Ionosphere

A number of objections to Ya. L. Al'pert's article "On a Method of Investigating the Ionosphere With the Aid of an Artificial Earth Satellite" (Uspekhi Fizicheskikh Nauk, Vol 74, No 1, Jan 58) are voiced by K. I. Gringauz in a letter to the editor of the above publication. Gringauz makes the following criticisms.

The direct measurement of the parameters characterizing the state and behavior of any medium can be accomplished even if the free path of the particles forming the medium exceeds the dimensions of the instruments despite Al'pert's statement to the contrary.

Expressions for the phases of signals and for the frequencies of these signals received from a satellite are given in Al'pert's article. The frequencies are considered constant. Gringauz states that the frequencies must be (according to Al'pert's arrangement) a function of time, i.e., contain doppler components. In these formulas, as a result of errors in printing, k values are wrongly expressed; as a result, the phase acquires an unnatural dimension.

In determining the effect of the ionosphere on the frequency of the satellite's signals, Gringauz says that it is impossible to ignore the vertical velocity of the satellite for values at any observation point, for despite the comparative smallness of this component of velocity, the effect created by it is very large.

In determining the parameters of ionospheric heterogeneities along the trajectory of the satellite's path, Al'pert assumes that the linear dimensions of small scale heterogeneities are identical in all regions of the heights from the lower limits of the ionosphere up to the satellite's

orbit. Gringauz says that this assumption is purely arbitrary and has no basis if the different physical conditions in various regions of the ionosphere are considered. If the altitude is not considered in determining these parameters, the results of the measurements cannot characterize heterogeneities along the satellite's trajectory. Measurements of the fluctuation of doppler frequencies of the phase of oscillations received from the satellite at a specific observation point, says Gringauz, can only characterize the fluctuation of the integral electron concentration in a column from the satellite down to the observer and nothing more.

Gringauz says that the study of the different characteristics (among them, doppler frequencies) of radio waves radiated from artificial earth satellites and received on the ground can and have given valuable information concerning the properties and state of the ionosphere. He concludes that the method of investigating the ionosphere described by Al'pert in his article is, on the basis of the exceptions presented above, insufficiently correct and cannot be used for measuring those parameters of the ionosphere which are spoken of in Al'pert's article. ("Regarding Ya. L. Al'pert's Article 'On a Method of Investigating the Ionosphere With the Aid of an Artificial Earth Satellite," by K. I. Gringauz, Moscow, Uspekhi Fizicheskikh Nauk, Vol 69, No 2, Oct 59, pp 345-347)

Soviet Report on Sixth International Conference on Cosmic Rays

A report by V. M. Fedorov, on the Sixth International Conference on Cosmic Rays, held in Moscow by the International Union of Theoretical and Applied Physics on 6-11 July 1959, follows.

The International Union of Theoretical and Applied Physics held the Sixth International Conference on Cosmic Rays in Moscow from 6 to 11 July 1959. Some 180 delegates from 24 countries, representing more than 70 different laboratories throughout the world, arrived at the conference.

The work of the conference took several directions. Principal attention, however, was focused on research of the interaction, mainly, of nuclei with superhigh energies (10^{11} electron volts and higher). Very valuable experimental data was presented in the reports of M. Shine's group (US), which established that the probability of nucleon-nucleon interactions with energies exceeding 10^{12} electron volts is determined only by the geometric dimensions of the nucleon perpendicular to the line of its flight.

The results obtained by N. A. Dobrotin and N. L. Grigorov's group in studying the interaction of nucleon-nucleon interactions with energies more than 10^{11} electron volts were equally interesting. The authors used a new instrument which they themselves developed, an "ionization

calorimeter" in the measurements, which is apparently extremely promising for research in such high energy fields. An analysis of the data concerning the interaction of particles with energies of 1-5 x 10^{11} electron volts made it possible to determine the number of secondary charged particles generated in such interactions, of their distribution according to angles, energies, and cross section impulses, and also the portion of energy transmitted by π -mesons. The individual acts of such interactions differ very strongly from one another in their characteristics. This indicates the presence of pecularities in the structure of nucleons.

The Bristol group of researchers (P. Fowler, D. Perkins, etc.) obtained extremely valuable information on this same problem. Many works devoted to the theoretical consideration of the problem of high energy interactions were presented, mainly by Soviet (Ye. L. Feynberg and others) and Japanese physicists.

A number of investigations presented at the conference were connected with the study of the structures and also the spatial distribution of flows of energy which are carried by various components of wide atmospheric showers caused by cosmic particles of superhigh energies. Thus, the S. N. Vernov group for the first time obtained a range of experimental data characterizing wide atmospheric showers of cosmic rays at sea level, and in particular, the energy spectrum and spatial distribution of flows of energy of the electron-photon components and data on the μ-meson component. An analysis of these data compels us to propose that the origin of μ -mesons occurs not only with the decay of π or K-mesons, but also in other as yet unknown processes. The careful study of this problem will make it possible to construct a more complete theory of the process of the multiple formation of superhigh energy particles.

The participants paid great attention to reports concerning the investigations of cosmic radiation conducted with the aid of satellites and rockets. In the works of A. Van Allen (US) on the results of observations with Explorer I and Explorer II and of S. N. Vernov and A. Ye. Chudakov on data obtained with the aid of the second and third Soviet artificial earth satellites, the existence of two zones (an inner and an outer) of high intensity radiation with a "gap" between them, where the intensity is weaker by approximately an order of one, were definitely established. The position and boundaries of the zone relative to the Earth and the composition and energy characteristics of the particles in them were studied. Thus, it was established that the overwhelming majority of the particles in the outer zone are electrons with energies of 20-100 kilo-electron-volts.

The radiations in the inner and outer zones differ sharply in composition. In the internal zone the radiation consists mainly of high energy particles (more than 10^6 per particle).

An explanation of the mechanism of the formation and accumulation of particles in the zones was of particular interest. The participants of the conference approved the results obtained by S. N. Vernov and A. I. Lebedinskiy in considering the possibility of the accumulation of a large number of secondary particles containing quasiperiodic motions around the lines of force from one hemisphere to the other. In this case, the motion of particles in the magnetic field must occur in this manner so that its magnetic moment will remain constant. Then the charged particle appears to be, as it were, "locked" in the region of a comparatively weak magnetic field. Inasmuch as the particle can complete many oscillations, their intensity [oscillations], correspondingly, highly increases.

A separate session was devoted to the origin of cosmic rays and allied astrophysical processes. Recent investigations indicate that the basis for the origin of cosmic rays apparently should be considered as being in the formation of Type I superhigh [energy ?] stars.

Investigations on variations of cosmic radiation were sharply intensified in connection with the conduct of the IGY. Thanks to the extensive net of stations, it is possible to rather reliably study the separate, individual changes in the intensities of cosmic rays and to associate them with concrete phenomena in the earth's atmosphere, in the geomagnetic field, and in the atmosphere of the Sun. This to a great degree assists in the deeper study of the reasons causing variations in cosmic rays. An understanding of the mechanisms of the variations will give valuable information on the corpuscular flows of magnetized fields and on the composition of the interplanetary medium, the solar and terrestrial atmospheres, and on the processes originating in them.

A single procedure for the introduction of corrections for meteorological effects in data obtained with the aid of meson telescopes which will permit considerable expansion of this field of investigation were widely discussed at the conference and accepted. ("Conference on Cosmic Rays," by V. M. Fedorov; Moscow, Vestnik Akademii Nauk SSSR, No 10, Oct 59, pp 77-78)

Fall of Meteorite in Azerbaydzhan Reported

The recent fall of an iron meteorite in the mountains region of Yardymlinskiy Rayon of Azerbaydzhan has been reported. On this morning, Yardymlinskiy Rayon was covered by a dense fog. At 0805 hours local time, a blinding flash appeared in the air which illuminated an area within a radius of 30 kilometers. After this, very strong rolling peals of thunder were heard.

Five fragments of the meteorite were found. The largest weighs 127 kilograms. ("Fall of a Meteorite"; Moscow, Izvestiya, 13 Dec 59, p 4)

Czechoslovaks Develop Clock Based on Semiconductors

Associates of the Prague Institute of Radio Engineering and Electronics are reported to have developed clocks on semiconductors. Time variation is said to be plus or minus 0.002 second in 24 hours. The clocks are better than the best marine chronometers. They are intended for use in astronomy and geophysics. ("Clocks on Semiconductors"; Kiev, Robochaya Gazeta, 12 Nov 59)

IV. SEISMOLOGY

Some Results of Investigation of Earthquakes in Kurile-Kamchatka Zone

The Kurile-Kamchatka zone is one of those with the greatest seismic activity in the USSR and in the Pacific Ocean seismic belt. The detailed study of the earthquakes in this zone is therefore of great interest. The results of the observations in this zone are used to establish the seismic activity of this region. The high seismic activity of the zone permits the accumulation of comprehensive material during a relatively short time which can be used for investigating the causes and conditions of earthquakes and the peculiarities of seismic wave propagation.

A report on the results of such observations was delivered at the Geophysical Institute, Charles University, Prague, on 14 October 1958, by N. V. Kondorskaya, Institute of the Physics of the Earth, Academy of Sciences USSR. The report, in particular, covered the travel time of seismic waves for the Kurile-Kamchatka zone, the generalization and analysis of earthquake observations at USSR seismic stations from 1954-1957 to study the seismic activity of the region (distribution of foci in space and time), and the study of the dynamic peculiarities of earthquake waves in the zone. ("Some Results of Observations of Earthquakes of the Kurile-Kamchatka Zone," by N. V. Kondorskaya, Institute of the Physics of the Earth, Academy of Sciences USSR; Prague, Studia Geophysica et Geodetica, Vol 3, 1959, pp 360-368)

Soviets Complete Work on Volcanological Regioning

The great work on volcanological regioning, that is, the determination of the zone in which the action of volcanos can extend in case of their eruption, has been completed by the collective of the Laboratory of Volcanology of the Academy of Sciences USSR.

The work of the Soviet scientists aroused interest at the symposium of the International Association of Volcanology recently held in Paris. Here precautionary measures from the danger of eruptions were developed. The proposals of the Soviet scientists were entered in the basis of these measures. ("Volcanological Regioning"; Moscow, Izvestiya, 13 Dec 59, p 6)

V. GRAVIMETRY

Geoid Determination From European Astronomic-Geodetic Nets

This work represents an independent solution of the problem of suitable dimensions and of a suitable orientation of the reference ellipsoid. The solution uses two different methods, namely, a derivation by means of the translative surface method and of the projective surface method.

The classical theory of the translative method was earlier supplemented by reforming the coefficients of the graduation equations in such a way that the coefficients appear merely as functions of the geodetic coordinates, ile., that they contain neither the length of the geodetic line nor its azimuth (Studia geoph, et geod., 1(1957), 1). This reforming is of practical value, since the solution of the second geodetic main problem is superfluous in the development of the graduation equations for any astronomic-geodetic point. The basic terms of the reformed coefficients have a simple form. Diagrams were prepared for the determination of the correction terms.

The major semiaxis of tne ellipsoid is also derived in the theory of the projective surface method. The accuracy of the solution here is about equal to the deviation of the original ellipsoid from the derived ellipsoid at the point of departure.

The theories of both methods require that the graduations employed be referred to a uniform geodetic system. This required that partial geodetic systems had to be carried over into a selected uniform system. The reference surface of this uniform system is the Bessel ellipsoid oriented with its initial point at the Helmertturm in Potsdam.

The solution is based on a total of 708 astronomic-geodetic points from the nets of Finland, Norway, Sweden, Denmark, East Germany, West Germany, Belgium, the Netherlands, Great Britain, France, Switzerland, Austria, Czechoslovakia, Poland, the USSR, Hungary, Rumania, Yugoslavia, Bulgaria, Italy, Spain, and Algeria.

All these nets were worked out by means of the translative method. In the projective surface method, however, it is assumed that the treatment is done by means of the projective method. Thus, the astronomic-geodetic plumb-line deviations were transformed from the translative system into the projective system, whereby the principle suggested by Molodenskiy ("Fundamental Problems of Geodesic Gravimetry," Trudy TsNIIGAiK, 42, 1945) was employed.

An additional new solution of the problem is presented. In the practical application, however, the transformation could be carried out only in approximate form, since the systematic influence exerted by the enlargement of the net was distorted as a result of the equalization of the nets.

The following conclusions are drawn.

1. The attempt to carry over the translative system of plumb-line deviations into the projective system is considered successful. When corrections are introduced, the projective method leads to practically the same results as the translative method; both methods are equally accurate, provided the corrections are employed properly. The projective method, however, is the simpler, since the coefficients in the equations for the plumb-line deviations have a very simple form. Although the differences in the various solutions here are negligible, the use of expanded astronomic-geodetic nets over entire continents would lead to unreliable values.

2. The oblateness of the ellipsoid cannot be derived with satisfactory accuracy from the astronomic-geodetic nets used here.

3. The solution obtained here confirms the fact that the Bessel ellipsoid is not suitable as a reference surface for European astronomic-geodetic nets. The same is true of the Hayford ellipsoid. The Krassowski ellipsoid is found to be the most suitable reference ellipsoid for the treatment of European astronomic-geodetic nets. ("Determining the Dimensions of the Ellipsoid of the Earth From the European Astronomic-Geodetic Nets," by M. Bursa, Geodetic Research Institute, Prague; Prague, Studia Geophysica et Geodaetica, Vol 3, No 4, 1959, pp 297-333)

Determination of Relative Plumb Line Deviations

This article is a continuation of an earlier work (Studia geophys. et geod., 2 (1958, 101)) which suggested a method of exact altitude determination and simultaneous determination of the relative deviations of the plumb line and of the refraction coefficient on the basis of the measurement of vertical angles, the line-of-sight lengths of which can extend to 12-15 kilometers. The results of an equalization of three small nets did not contradict independently conducted control measurements, but the number of control measurements was not sufficient.

Within the framework of a research project on the determination of a method of determining the epirogenetic motions in mountainous areas, the trigonometric net in the western part of the High Tatra was surveyed. The purpose was to compose and test an economic method of exact measurement of altitude angles in the high mountains, to solve the problem of

the changes of refraction during a 24-hour period and during longer periods, to determine the profile of the relative geoid, and to check the computed heights, plumb line deviations, and refraction coefficients by means of a leveling method. The results justified the further development of the method. Since an exact determination of altitude in hilly and mountainous regions is also necessary for planning mountain communications systems, the suggested method was also studied from the viewpoint of current technical practice.

The possibility of determining the refraction and plumb line deviations during the equalization of trigonometric mountain nets was established in theory and confirmed by control measurements. The computed relative plumb line deviations correspond to the local distribution of mass, and the profile plotted on the basis of these deviations is in good agreement with the trigonometrically measured altitudes and the altitudes established by the leveling method.

Even though the controls show final errors of plus one centimeter and plus 3 centimeters between the leveled and trigonometrically established altitudes along two 17-kilometer distances, the values for the computed altitudes and plumb line deviations must be considered only provisional, since several necessary requirements were not fulfilled in surveying the net, namely, the line-of-sight signals were small, several net points were unsatisfactory, and only one set of angles was measured for several points because of variable weather.

The most important prerequisite for obtaining good results was found to be an exact and reliable measurement of the angle of elevation, which depends on a suitable measuring method, suitable form of line-of-sight signals, and choice of stations on steep mountain peaks of measurement columns at least 12-15 meters high. ("Determination of the Relative Plumb Line Deviations and of the Refraction Coefficient in the Equalization of Trigonometrically Measured High-Altitude Nets (Continuation)," by L. Hradilek, Chair of Applied Geophysics, Karls University, Prague; Prague, Studia Geophysica et Geodaetica, Vol 3, No 4, 1959, pp 334-359)

VI. ARCTIC AND ANTARCTIC

Nonzonal Antarctic Circumpolar Current

An analysis of dynamic charts and of the literature on the subject indicates a substantial influence of the bottom relief on the Antarctic circumpolar current. This conclusion is based on the known fact that this particular current extends to the very bottom of the ocean. The relatively small change of density with depth in the Antarctic waters means that the vertical velocity of the current is more uniform than in

other parts of the ocean. The equation for the function of gross flows Ψ is modified to make it possible to obtain a sufficiently accurate determination of the isoline of the function Ψ without solving the original equation. The form of the line of flow (isoline of Ψ) is determined by constructing the isolines of the function $\sin \varphi/H$ (φ = latitude; H = depth). The form of the line of flow is determined jointly by the influence of the latitudinal change of the Coriolis parameter and the relief of the bottom. It is possible that the results obtained in this study can provide information on the circulation of the water in little-studied regions of the Antarctic. ("Relief of the Bottom as the Principal Factor Responsible for the Nonzonal Course of the Antarctic Circumpolar Current," by Yu. A. Ivanov and V. M. Kamenkovich, Institute of Oceanology, Academy of Sciences USSR; Moscow, Doklady Akademii Nauk SSSR, Vol 128, No 6, 21 Oct 59, pp 1167-1170)

Russian Geographical Names in Antarctica

During the preparation and conduct of the IGY, members of the Soviet Antarctic Expedition did a great amount of surveying and hydrographic work on the east coast of Antarctica and in the adjoining waters. As a result, the outlines of the Antarctic continent were defined with complete accuracy and new geographical objects were discovered, which have been given the names of well-known Soviet scientists, seamen, pilots, and polar explorers.

The "List of Geographical Names of East Antarctica," recently published by the Arctic and Antarctic Institute, includes all names assigned to geographical features as a result of the activities of the Soviet Antarctic Expedition, as well as all previously existing names. The foreign names of objects, whose location had been determined approximately by foreign expeditions and which were newly determined by the Soviet Expedition, are not included in the list. The "List" includes a total of over 750 names. ("Geographical Names of East Antarctica," Ashkhabad, Turkmenskaya Iskra, 20 Nov 59)

Kooperatsiya Leaves for Antarctic

The diesel ship Kooperatsiya left the Leningrad port on 25 November 1959 on its antarctic voyage, carrying members of the Fifth Soviet Antarctic Expedition, scientific equipment, provisions, and other cargo.

The main component of the expedition had already left for Antarctica on 12 November on the Ob'. Three meteorologists from the GDR and three scientists from Czechoslovakia are with the Soviet expedition aboard the Ob'.

Among the passengers of Kooperatsiya is a group of staff members of the interior station Vostok, headed by V. S. Sidorov.

The Kooperatsiya is headed for the polar observatory at Mirnyy. This is the third voyage of the ship to Antarctica. ("Antarctic Voyage of 'Kooperatsiya,'" Moscow, Trud, 26 Nov 59)

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